10/pats



Specification

# Rotary Folder Comprising a Cutting Device for Cross-Cutting at Least One Web

The invention relates to a wheel folding apparatus with a cutting device for the transverse cutting of at least one web of material in accordance with the preamble of claim 1.

Such a wheel folding apparatus is employed, for example, in order to separate paper webs imprinted in a web-fed rotary printing press into individual signatures by means of the cutting device, and to fold the signatures,

Known wheel folding devices of this type comprise cutting devices with a transport cylinder and a cutting cylinder, which are mutually rotatable and delimit a gap through which a conveying path for the web of material to be cut extends. The cutting cylinder supports at least one cutter, which cuts respectively one signature off the web of material when it passes through the gap.

DE 25 17 000 C2 shows a folding apparatus with a spur cylinder and cutting blade cylinder, which form a single cutting gap.

DE 35 27 710 A1 and EP 0627 310 A1 disclose folding apparatus, wherein two folding blade cylinders work together with a folding jaw cylinder. A single cutting cylinder is assigned to each one of these folding blade cylinders.

The object of the invention is based on creating a wheel folding apparatus with a cutting device for transverse cutting of at least one web of material.

In accordance with the invention, this object is attained by means of the characteristics of claim 1.

The advantages which can be obtained by means of the invention lie in particular in that with little outlay for apparatus it makes possible the combining of two webs of material, which are fed to the cutting gaps on two transport carriages, into a common product, or that it allows the processing of a web of material with a very large number of layers by combining two partial webs.

Processing of webs of materials composed of a large number of layers by means of a folding apparatus with a single cutting gap, such as described in DE 25 17 000 C2, entails difficulties for several reasons. For one, traction rollers, which are customarily provided for setting a required tension in the web of material, directly act only on the respectively outermost layers of the web of material, their force is only indirectly transmitted to the inner layer by friction of the layers of material against each other. These frictional forces are not accurately controllable, in particular if it is necessary to guide the web around curves, i.e. to loop it around a roller. Therefore the tension of the inner layer of such a web is harder to control, the greater the number of rollers is. Also, the forces required for processing a web, be it during cutting or pushing the spur points into the web, are all the greater, the greater the number of layers is. With the wheel folding apparatus in accordance with the invention it is possible to combine a product with a defined number of pages from partial webs, which had been cut separately of each other and placed on the spurs. Since the forces required for cutting these partial webs and, if required for placing them on spur points, are less than the corresponding forces when processing a single

web with the defined number of pages, the wheel folding apparatus can be constructed lighter and therefore more cost-effectively without any loss in quality.

Further advantages lie in that the cutting device eliminates the danger of re-cutting already separated signatures in the course of a further passage through a cutting gap, without requiring elaborate shifting devices, or an extraordinarily high degree of precision when controlling the rotations of the individual cylinders of the cutting device for this.

To prevent the second cutting blade from again cutting through the first web during the passage through the second cutting gap, the rotation of the two cutting cylinders is preferably synchronized in such a way that during its passage through the second cutting gap the second cutting blade engages a cut created by the first cutting blade of the first web.

To make the engagement with this cut easier, means are preferably provided for moving apart the cut edges of the first web generated by the first cutter in the course of cutting it, so that during its passage through the gap the second cutter encounters a gap of non-vanishing width in the first web.

In an embodiment of the wheel folding apparatus, in which the cutting cylinder in the cutting device also takes on the function of a transport cylinder for the separated products, the single signature is located between the two cutters by which it had been cut as long as it is maintained on the cutting or transport cylinder, and it is sufficient during this time that the cutters and the signature do not

move in relation to each other, in order to assure that the signature is not cut again in the course of another passage through the cutting gap.

Exemplary embodiments of the invention are represented in the drawings and will be described in greater detail in what follows.

Shown are in:

Fig. 1, a schematic lateral plan view of a portion of a wheel folding apparatus with a cutting device,

Figs. 2 to 5, respectively partial sectional views of the transport cylinder and of one cutting cylinder in different embodiments of the invention,

Fig. 6, a schematic lateral plan view of a portion of different embodiment of a wheel folding apparatus with a cutting device,

Fig. 7, an enlarged representation of a detail in Fig. 6,

Fig. 8, a representation of a mode of operation,

Fig. 9, a representation of another mode of operation,

Fig. 10, a further exemplary embodiment of a wheel folding apparatus.

A schematic lateral plan view of a portion of a wheel folding apparatus is represented in Fig. 1. This wheel folding apparatus has two inlets 01, 02 for multi-layered webs 03, 04 of material, in particular paper webs 03, 04, which will be called inner or outer web 03, 04 in what follows. Both webs 03, 04 pass through respective traction roller pairs 06, 07 for setting their tension and meet a transport cylinder 11 at the respective height of cutting gaps 08, 09 between the transport cylinder 11 on the one hand

and one of the cutting cylinders 12, 13 on the other. Instead of two inlets 01, 02 and two cutting gaps 08, 09 it is also possible to provide three or more. In the course of this the webs 03, 04 preferably first make contact with the respective cutting cylinder 12, 13 and subsequently with the transport cylinder 11, the webs 03, 04 first loop around the cutting cylinder 12, 13 and then the transport cylinder 11.

Each cutting cylinder 12 or 13 has a circumference corresponding to at least one, preferably two lengths of the signatures 21, 27 to be produced from the webs 03, 04, and supports two cutters 14.

The circumference of the transport cylinder 11 corresponds to more than five, in particular seven lengths of the signatures 21, 27. Seven counter-cutting strips, for example hard rubber strips, inserted at equal distances into the circumferential face of the transport cylinder 11, are used as stops 33, each of which works together with a cutter 14 when cutting the webs 03, 04. A holding device 16 is arranged at the transport cylinder 11 adjoining each one of the stops 33, for example a spur strip 16 with extendible spur needles 23 (see Figs. 2 to 5).

In the position represented in Fig. 1, a cutter 14 of the cutting cylinder 12 and a stop 33 of the transport cylinder 11 just pass through the cutting gap 08 and in the process cut the inner web 03. The leading edge of the inner web 03 created during the cutting has been speared on the spur needles 23 of a spur strip 16 which had been extended immediately prior to reaching the cutting gap 08, and continue to hold it firmly on the surface of the transport cylinder 11 during further transport.

The signature 21 cut off from the inner web in this way 03 is conveyed on the transport cylinder 11 to the cutting gap 09, where the outer web 04 is placed on top of it and is also speared by the spur needles 23 of the spur strip 16.

The rotation of the two cutting cylinders 12, 13 is synchronized in such a way that a cutter 14 of the cutting cylinder 13 always passes through the cutting gap 09 simultaneously with a small gap between two successive signatures 21 cut from the inner web 03 and a stop 33. Different techniques for creating this gap will be explained in what follows with the aid of Figs. 2 to 5.

In the example represented here, the angular distance between the two cutting gaps 08, 09 is approximately 50°. This angular distance can differ from the angular distance between the spur strips 16 from each other (51.5°) or a multiple thereof, so that cutting is not performed simultaneously at both cutting gaps 08, 09; even a half-number multiple of this value is disadvantageous from the point of view of avoiding vibrations.

Following the passage through the cutting gap 09, each spur strip 16 supports a total product which is respectively composed of a signature 21 cut off the inner web 03 and a signature 27 cut off from the outer web 04. Seven products are created with each revolution of the transport cylinder 11, the same as if both webs 03, 04 had been brought along in the customary manner via a common inlet 01, 02. But since the cutting off of each individual signature 21, 27 is spread over two cutting steps at the cutting gaps 08, 09, the force which must be employed in each cutting step is less, and

satisfactory even running of the machine can be more easily maintained.

Furthermore, two cylinders 17 and 18, in particular folding rollers 17 and 18 which together form a gap 19, in particular a folding gap 19, have been placed in a contactless manner against the cutting and transport cylinder 11. Seven folding blades, not represented in Fig. 1, are attached to the transport cylinder 11, each of which is extended when reaching the folding gap 19 between the transport cylinder 11 in order to push the products transported on the transport cylinder 11 in a manner known per se into the folding gap 19, leading with a desired fold line located approximately centered on the sides of the signatures 21, 27, and to fold them in this way. The folded products pass through the folding gap 19 and, in a known manner, fall onto a paddle wheel, not represented, and are placed by it on a conveyor belt.

Fig. 2 shows a detailed view of the cutting gap 09 and its surroundings in accordance with a first embodiment of the invention. Two of the seven spur strips 16 of the transport cylinder 11 are represented in Fig. 2 and identified as spur strips 16', 16". Each of them is pivotable around a shaft 22 in a controlled manner and has spur needles 23 which are oriented in such a way that their respective tips extending from the circumference of the transport cylinder 11 are farther away from the center of the shaft 22 than their bases located inside the transport cylinder 11. The spur needles 23 of the spur strip 16' are in a comparatively far extended position, in which they had also previously passed through the cutting gap 08. This

identical position is shown by dashed lines at the location of the spur strip 16".

In comparison with this, the spur strip 16" has been pivoted back some distance into the interior of the transport cylinder 11. This pivot movement causes a displacement of the intersection point between the spur needles 23 and the surface of the transport cylinder 11 opposite the direction of rotation of the latter. By means of this displacement the signature 21 held by the spur strip 16" has been slightly shifted opposite the direction of rotation of the transport cylinder 11 in comparison to the position in which it had been cut off the inner web 03 in the cutting gap 08. Following the passage through the cutting gap 09, the spur strip 16" returns into the position shown in dashed lines, or even changes to a further extended position in order to cancel, or overcompensate, the rear displacement of the signature 21 in this way. A small gap 26 is created in this way between the signature 21 and a signature 27 which had been cut off immediately prior to this, into which the cutter 14 can extend and in this way press the inner web 04 against the stop 33 and sever it, without the danger arising of again cutting one of the signatures 21, 27.

Fig. 3 shows an alternative embodiment of the transport cylinder 11 and the cutting cylinder 13 in a partial sectional view analogous to that of Fig. 2. In connection with each cutter 14, the cutting cylinder 13 has a strip 28, which projects past its outer circumference and which passes through the cutting gap 09 respectively shortly ahead of the associated cutter 14. A complementarily shaped groove 29 in the transport cylinder 11 is located opposite the strip 28

during each gap passage, so that the strip 28 presses a trailing edge area of the signature 27 cut off the outer web 04, as well as the outer web 04, into the groove 29. The trailing edge of the signature 27 is pulled ahead by this and the gap 27 is opened. Therefore with this embodiment it is not necessary for the spur strip 16" to pivot outward again after its passage through the cutting gap 09 for creating the gap 26.

A third embodiment is represented in Fig. 4, again by means of a partial sectional view through the transport cylinder 11 and the cutting cylinder 13. The cutting cylinder 13 is identical to the one in Fig. 2, the transport cylinder 11 differs by the arrangement of the shafts 22 around which the spur strips 16 are pivotable. While in the embodiment in accordance with Figs. 2 and 3 these shafts 22 are located ahead of the spur needles 23 in the direction of rotation of the transport cylinder, they are arranged behind these in the embodiment of Fig. 4. The orientation of the spur needles 23 in relation to the surface of the transport cylinder 11 is the same in all cases, they are slightly inclined forward in the direction of rotation of the transport cylinder 11 in respect to the normal surface line, so that a tension acting on the material speared on the spur needles 23 keeps them pressed against the surface of the transport cylinder 11.

A changed course of the pivot movement of the spur strips, here identified by 16*, 16**, results from the changed arrangement of the shafts 22. The spur strip 16*. which is still far distant from the cutting gap 09, is in a position in which it is comparatively little extended, in

which its spur needles 23 extend far enough past the circumference of the transport cylinder 11 for holding the inner web 03. The spur strip 16* is farther extended only shortly before reaching the cutting gap 09 in order to also puncture the outer web 04, which can be perceived at the spur strip 16**. With this embodiment the upward movement of the spur needles 23 causes a shifting of their intersection with the circumference of the transport cylinder 11 opposite the direction of movement of the latter and therefore the movement of the leading edge of the signature 21 held by the spur strip 16** away from the impact point of the cutter 14 on the stop 33. In contrast to this, the spur needles 23 of the spur strip 16*** have been retracted a short distance into the transport cylinder 11 in order to thus move the signature 27 they are holding forward in the circumferential direction and in this way to open the gap 26 at the height of the stop 33.

With this embodiment several direction changes of the movement of the spur needles 23 in the course of the revolution of the transport cylinder 11 are avoided.

A fourth embodiment of the cutting device is represented in Fig. 5, again in a plan view analogous to Fig. 4.

In this embodiment, segments 32', 32" ..., are arranged on the circumference of the transport cylinder 11 respectively between two successive spur strips 16', 16", 16''', ... , for increasing the circumference. Each one of these segments 32', 32" is composed of a plurality of flexible disks, which are arranged side-by-side in the axial direction of the transport cylinder 11 and are spaced apart

by gaps. In the course of passing the finished cut signatures 21, 27 on to the folding rollers 17, 19, these gaps are used as the outlet openings for tines of a folding blade (not represented). The ends of each of the disks are anchored on head strips 31 which can be shifted in the circumferential direction of the transport cylinder 11.

The segment 32' is in a configuration wherein the course of its disks corresponds to the cylindrical shape of the transport cylinder 11. After such a segment 32' has passed through the cutting gap 09, its head strips 31 are shifted toward each other, so that its disks form a protrusion extending beyond the circumference of the transport cylinder 11, as shown by means of the segment 32". Because of this protrusion, the distance between the spur strips 16" and 16''', measured along the surface of the transport cylinder 11, is greater than the one between the spur strips 16' and 16", the latter corresponds to the length of the signatures 21, 27 created at the cutting gap 06. Therefore the bulging of the segment 32" causes the creation of the gap 26 between the signatures 21 and 27, into which the cutter 14 of the cutting cylinder 13 can extend.

The cutting cylinder 13 is arranged on the circumference of the transport cylinder 11 so that it cuts in a phase-shifted manner.

The cut of the cutting cylinder 12 on the transport cylinder 11 takes place close to, in particular 10 mm, next to the other cut of the cutting cylinder 13.

The cutting cylinders 12 and 13 are arranged in the circumferential direction on the transport cylinder.

Fig. 6 shows a schematic lateral view of a portion of an alternative embodiment of the wheel folding apparatus, wherein the cutters 14 are arranged on the transport cylinder 11. The circumference of the cutting and transport cylinder 11 corresponds to more than five, preferably seven lengths of the signatures 21, 27. It supports more than five, preferably seven cutters 14 evenly distributed over its circumference and, in its movement direction (rotation in a counterclockwise direction in Fig. 1), a holding device 16, for example a spur strip 16, closely behind each cutter 14. Such a spur strip 16, which is pivotable around the shaft 22 and carries spur needles 23, is represented enlarged in Fig. 7 at the moment of its passage through the cutting gap 06 in the counter cylinder 34.

Each one of the two identically constructed counter cylinders 34 or 36 has a circumference corresponding to at least one, preferably two lengths of signatures 21, 27 to be produced from the webs 03, 04. It supports at least one, preferably two counter-cutting strips, for example hard rubber strips, sunk into its circumferential surface, which are used as stops 33 for the cutter 14, as well as a groove 24 closely behind each stop 33 for receiving the tips of the spur needles 23 of the spur strips 16 which had been extended past the circumference of the cutting and transport cylinder 11 during the passage through the cutting gap 08 or 09.

In the position represented in Fig. 6, a cutter 14 of the cutting and transport cylinder 11 and a stop 33 of the counter cylinder 34 just pass through the cutting gap 08 and in the process cut through the inner web 03. The leading edge of the inner web 03 being created by cutting has been

speared on the spur needles 23 of a spur strip 16, which had been extended shortly before reaching the cutting gap 08, which continue to hold it firmly during further transport on the surface of the cutting and transport cylinder 11.

The signature 21 cut off the inner web 03 in this way is further conveyed on the cutting and transport cylinder 11 to the cutting gap 09, where the outer web 04 is placed on top of it, is also speared by the spur needles 23 of the spur strip 16 and is cut by the same cutter 14. Since the cutters 14 and the spur strips 16 do not move in relation to the cutting and transport cylinder 11 between their passage through the cutting gap 08 and the cutting gap 09, there is no danger that the signatures 21, which had been cut off the web 03 in the cutting gap 08, will be cut again during their passage through the cutting gap 09.

At the location of the cutting gaps 08 and 09, the tips of the spur needles 23 (see Fig. 7) extend farther past the circumference of the cutting and transport cylinder 11 than the cutters 14 in order to assure that they already have penetrated through the webs 03 or 04 before the latter are being cut by the cutter 14.

The angular distance between the two cutting gaps 08, 09 is approximately 50° in the example represented here. This angular distance can differ from the angular distance between the spur strips 16 from each other (51.5°) or a multiple thereof, so that cutting is not performed simultaneously at both cutting gaps 08, 09; even a half-number multiple of this value is disadvantageous from the point of view of avoiding vibrations.

Following the passage through the cutting gap 09, each spur strip 16 supports a total product which is respectively composed of a signature 21 cut off the inner web 03 and a signature 27 cut off from the outer web 04. Seven products are created with each revolution of the transport cylinder 11, the same as if both webs 03, 04 had been brought along in the customary manner via a common inlet 01, 02. But since the cutting off of each individual signature 21, 27 is spread over two cutting steps at the cutting gaps 08, 09, the force which must be employed in each cutting step is less, and satisfactory even running of the machine can be more easily maintained, and the demands made on the mechanical load-bearing capability of the cutting device are less than if they were fed in via a common inlet 01, 02.

Furthermore, at least five, preferably seven folding blades, which are not represented in the drawing figure, are attached to the cutting and folding cylinder 11 and which, each time they reach a folding gap 19 between two folding rollers 17 and 18 placed in a contactless manner against the cutting and transport cylinder 11, are extended for transferring the products transported on the cutting and transport cylinder 11 into the folding gap 19 in a manner known per se, and fold them. The folded products pass through the folding gap 19 and, in a known manner fall onto a paddle wheel, also not represented, since it is known, and are placed by it on a conveyor belt.

A modified embodiment of the cutting device differs from the one represented in Fig. 6 in that it has only a single inlet 02 for a single web 04 to be cut. Reference is

made to Fig. 6 in describing it, wherein the inlet 01, the web 03 and the counter cylinder 34 are assumed not to exist.

It is possible that each one of the webs 03, 04 has identical patterns A and B one behind the other, i.e. in the transport direction. Preferably these patterns A and B are printed by at least one forme cylinder of a printing unit, which carries two identical patterns A and B on its circumference. The webs 03, 04 are conducted on top of each other, so that signatures with patterns A and B resting on top of each other are created, each of which is moved to the folding gap 19. To this end it is not absolutely necessary for the transport cylinder 11 to have an odd division and instead it can also have an even division, preferably greater than 4 or 6.

Preferably each of the patterns A, B, C, D identifies two newspaper pages, wherein A1, A2, B1, B2, C1, C2, D1, D2 each identify one newspaper page. At least one web 03, 04 is to be understood by the identification web 03, 04, however, preferably this is to be understood as a continuous web consisting of several webs 03, 04 placed on top of each other.

In this case the webs 03, 04 can each be imprinted by forme cylinders of printing units which either have a pattern A or B on the circumference (single circumference), or two patterns A or B on the circumference (double circumference). In the case of double circumference forme cylinders, two identical patterns A, A and B, B, or two different patterns A, B can be arranged on the circumference.

Therefore four modes of operation are possible when employing the wheel folding apparatus in accordance with the invention.

In a first and second mode of operation, both webs 03, 04 are brought together upstream of the first inlet 01 on the transport cylinder 11 and are cut by means of a single cutting process.

In a first mode of operation, the webs 03, 04 here have the same patterns A or C, as can be seen in Fig. 8, and identical products are formed one behind the other on the transport cylinder 11 during each revolution and are directly delivered to the folding gap 19.

In a second mode of operation corresponding to a collection operation, the webs 03, 04 have alternating patterns A, B or C, D, one behind the other, as represented in Fig. 9, which, in the course of a first revolution, are alternatingly deposited on the transport cylinder 11 (= collection cylinder), which is provided with an odd number of fields. Fields of the transport cylinder 11, which carry signatures with patterns A, C, move past the folding cylinders 17, 18 without the signatures being delivered. During a second passage of such a field past the inlet 01 it is additionally loaded with signatures with the patterns B, D. Only then are all four signatures delivered together to the folding gap 19.

In a third and fourth mode of operation, the two webs 03, 04 are separately fed via the inlet 01, 02.

In the third mode of operation, the webs 03, 04 carry patterns A, B or C, D alternatingly one behind the other in accordance with Fig. 9.

In this case, in the course of a first revolution of the transport cylinder 11 (= collecting cylinder), a first field of the transport cylinder is loaded with a signature with the pattern A at the inlet 01, and with a signature with the pattern C at the inlet 02, so that every second spur strip 16 carries signatures with the patterns A, C when passing the folding cylinders 17, 18, and passes the cylinders without delivering the signatures. In the course of a second revolution, two signatures with patterns B, D from the webs 03, 04 are then again conducted on the spur strips 16.

Therefore, during the second revolution of the transport cylinders 11, signatures with patterns A, B, C, D on the spur strips 16 alternate with spur strips 16 which only carry signatures with the patterns A, C, wherein the finished products, consisting of four signatures with patterns A, B, C, D of each second field are transferred to the folding gap 19.

In a fourth mode of operation, the webs 03, 04 have the same patterns A, A, or C, C in succession, as in Fig. 8, so that during each revolution of the transport cylinders 11 each spur strip 16 picks up signatures with the patterns A, C, which are directly transferred to the folding gap 19 when it is reached.

In a further exemplary embodiment, the transport cylinder 11 has three holding devices 16, preferably spur needle sets 16. Two folding blades have been arranged. These folding blades are rotatably arranged on a rotatable support inside the shell surface of the transport cylinder 11. This support is arranged eccentrically in respect to the

axis of rotation of the shell surface of the transport cylinder 11 and rotates at a relative speed in respect to the shell surface of the transport cylinder 11. Two cutting arrangements are assigned to this transport cylinder, so that two cutting gaps 08, 09, which are arranged offset, are provided on the circumference.

Each of these cutting arrangements has rotatable cylinders 12, 13, or 34, 36, which are either provided with at least one cutter 14 or at least one stop 33 for a cutter 14.

If the cylinders 12, 13 have cutters 14, stops 33, preferably three, are arranged on the transport cylinder 11. But if the cylinder 34, 36 have stops 33, cutters 14, preferably three, are arranged on the transport cylinder 11.

List of Reference Symbols

| | |
|---|---|
| 01 | Inlet |
| 02 | Inlet |
| 03 | Web of material, web, first, inner, paper web |
| 04 | Web of material, web, second, outer, paper web |
| 05 | - |
| 06 | Traction roller pair |
| 07 | Traction roller pair |
| 08 | Cutting gap, first |
| 09 | Cutting gap, second |
| 10 | - |
| 11 | Transport cylinder, folding blade cylinder |
| 12 | Cutting cylinder, first, counter cylinder, first |
| 13 | Cutting cylinder, second, counter cylinder, second |
| 14 | Cutter |
| 15 | - |
| 16 | Means, holding device, spur strip |
| 17 | Cylinder, folding roller |
| 18 | Cylinder, folding roller |
| 19 | Gap, folding gap |
| 20 | - |
| 21 | Signature, first |
| 22 | Shaft |
| 23 | Spur needles |
| 24 | Groove |
| 25 | - |

| | |
|---|---|
| 26 | Gap |
| 27 | Signature, second |
| 28 | Strip |
| 29 | Groove |
| 30 | - |
| 31 | Means, segment head strip |
| 32 | Means, segment |
| 33 | Stop |
| 34 | Counter cylinder, first |
| 35 | - |
| 36 | Counter cylinder, second |